

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re The Application of:
Peter F. Corbett et al.
Peter F. Corbett et al.

Examiner: Kerveros, James C.

Serial No.: 10/035,607

Filed: December 28, 2001

For: Row-Diagonal Parity Technique for
Enabling Efficient Recovery From
Double Failures in a Storage Array

Cesari and McKenna, LLP
88 Black Falcon Avenue
Boston, MA 02210
July 7, 2005

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Sir:

## **INFORMATION-DISCLOSURE STATEMENT**

In keeping with the duty of candor and good faith owed to the Patent and Trademark Office, Applicants wish to bring to the Examiner's attention the references listed on the accompanying form PTO-1449. A copy of each listed reference is enclosed.

To the extent required by 37 C.F.R. §1.98(a)(3), Applicants have described what they consider to be the relevance of any foreign-language reference. The Office may find additionally relevant material in these or other references.

Please charge any additional fee occasioned by this paper to our Deposit Account No. 03-1237.

Respectfully submitted,

James A. Blanchette

Reg. No. 51,477

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	Complete if Known	
Application Number	10/035,607	
Filing Date	December 28, 2001	
First Named Inventor	Peter F. Corbett et al.	
Group Art Unit	2133	
Examiner Name	Kerveros, James C.	
Attorney Docket Number	112056-0031	フ

				U.S. PATENT DOCUMEN	TS	
	U.S. Patent Document			Name of Patentee or Applicant	Date of	Pages, Columns, Lines, Where Relevant
Examiner Initials *	Cite No.1	Number	Kind Code <sup>2</sup> (if known)	of Cited Document	Publication of Cited Document MM-DD-YYYY	Passages or Relevant Figures Appear
	1	Re. 34,100		Hartness	10-13-1992	
	2	3,876,978		Bossen et al.	04-08-1975	
	3	4,092,732		Ouchi	05-30-1978	
	4	4,201,976		Patel	05-06-1980	
	5	4,205,324		Patel	05-27-1980	
	6	4,375,100		Tsuji et al.	02-22-1983	
	7	4,467,421		White	08-21-1984	
	8	4,517,663		Imazeki et al.	05-14-1985	<u> </u>
	9	4,667,326		Young et al.	05-19-1987	
	10	4,688,221		Nakamura et al.	08-18-1987	·
	11	4,722,085		Flora et al.	01-26-1988	-
	12	4,755,978		Takizawa et al.	07-05-1988	
	13	4,761,785		Clark et al.	08-02-1988	
	14	4,775,978		Hartness	10-04-1988	
	15	4,796,260		Schilling et al.	01-03-1989	
	16	4,817,035		Timsit	03-28-1989	
	17	4,825,403		Gershenson et al.	04-25-1989	
	18	4,837,680		Crockett et al.	06-06-1989	
	19	4,847,842		Schilling	07-11-1989	
	20	4,849,929		Timsit	07-18-1989	
	21	4,849,974		Schilling et al.	07-18-1989	
	22	4,849,976		Schillling et al.	07-18-1989	
	23	4,870,643		Bultman et al.	09-26-1989	
	24	4,899,342	•	Potter et al.	02-06-1990	
	25	4,989,205		Dunphy, Jr. et al.	01-29-1991	
· · · · · · · · · · · · · · · · · · ·	26	4,989,206		Dunphy, Jr. et al.	01-29-1991	
	27	5,077,736		Dunphy, Jr. et al.	12-31-1991	
	28	5,088,081		Farr	02-11-1992	
	29	5,101,492		Schultz et al.	03-31-1992	
	30	5,128,810		Halford	07-07-1992	
	31	5,148,432		Gordon et al.	09-15-1992	
	32	5,163,131		Row et al.	11-10-1992	
	33	5,166,936		Ewert et al.	11-24-1992	
	34	5,179,704	-	Jibbe et al.	01-12-1993	
	35	5,202,979		Hillis et al.	04-13-1993	

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Attorney Docket Number	112056-0031	フ

		U.S. Pater	nt Document	Name of Patentee or Applicant		Pages Columns Lines Where Paleurs
Examiner Initials *	Cite No.1	Number	Kind Code <sup>2</sup> (if known)	of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	36	5,208,813		Stallmo	05-04-1993	
	37	5,210,860		Pfeffer et al.	05-11-1993	
	38	5,218,689		Hotle	06-08-1993	
	39	5,233,618		Glider et al.	08-03-1993	
	40	5,235,601		Stallmo et al.	08-10-1993	
	41	5,237,658		Walker et al.	08-17-1993	
	42	5,257,367		Goodlander et al.	10-26-1993	
	43	5,274,799		Brant et al.	12-28-1993	
	44	5,305,326		Solomon et al.	04-19-1994	
	45	5,351,246		Blaum et al.	09-27-1994	
	46	5,410,667		Belsan et al.	04-25-1995	
	47	5,537,567		Galbraith et al.	07-16-1996	
	48	5,579,475		Blaum et al.	11-26-1996	
	49	5,623,595		Bailey	04-22-1997	
	50	5,805,788		Johnson	09-08-1998	
	51	5,812,753		Chiariotti	09-22-1998	
	52	5,862,158		Baylor et al.	01-19-1999	
	53	5,884,098		Mason, Jr.	03-16-1999	
	54	6,092,215		Hodges et al.	07-18-2000	
	55	6,138,201		Rebalski	10-24-2000	
	56	6,158,017		Han et al.	12-05-2000	
	57	6,223,300	B1	Gotoh	04-24-2001	
	58	6,532,548	B1	Hughes	03-11-2003	
	59	6,581,185	Bl	Hughes	06-17-2003	
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		OTHER PRIOR ART NON PATENT LITERATURE DOCUMENTS					
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	60 ·	ANVIN, PETER H, "The Mathematics of RAID 6," December 2004 /					
	61	Auspex 4Front NS2000, System Architecture, Network-Attached Storage For a New/Millennium, Auspex Engineering Technical Report 24, January 1999					
	62 <sup>°</sup>	BESTAVROS, AZER, ET AL., Reliability and Performance of Parallel Disks, Technical Memorandum 45312-891206-01TM, AT&T, Bell Laboratories, Department 45312, Holmdel, NJ, December 1989					
	63 -	BITTON, DINA, Disk Shadowing, Proceedings of the 14th VLDB Conference, LA, CA (1988)	- <del>10</del>				
	64	BULTMAN, DAVID L., High Performance SCSI Using Parallel Drive Technology, In Proc. BUSCON Conf., pages 40-44, Anaheim, CA, February 1988					
	65	CHEN, PETER ET AL., <u>Two Papers on RAIDs.</u> Technical Report, CSD-88-479, Computer Science Division, Electrical Engineering and Computer Sciences, University of California at Berkeley (1988)					
	66 ´	CHEN, PETER M., ET AL., An Evaluation of Redundant Arrays of Disks Using an Amdahl 5890, Performance Evaluation, pp. 74-85, 1990 – check to see if exact same copy as one in WAFL					
	67	CHEN, PETER M, ET AL, Maximizing Performance in a Striped Disk Array, Proc. J 1990 ACM SIGARCH 17th Intern. Symp. on Comp. Arch., Seattle, WA, May 1990, pp. 322-331.	****				
	68 <sup>′</sup>	CHEN, PETER M., ET AL., RAID: High Performance, Reliable Secondary Storage, ACM Computing Surveys, 26(2):145-185, June 1994					
	69	CHERVENAK, ANN L., Performance Measurement of the First RAID Prototype, Technical Report UCB/CSD 90/574, Computer Science Division (EECS), University of California, Berkeley, May 1990	•				
	70 -	COPELAND, GEORGE, ET AL., "A Comparison of High-Availability Media Recovery techniques," in Proc. ACM-SIGMOD Int. Conf. Management of Data, 1989.					
	71 ′	COURTRIGHT II, WILLIAM V., ET AL., RAIDframe: A Rapid Prototyping Tool for RAID Systems, Computer Science Technical Report CMU-CS97-142, Carnegie Mellon University, Pittsburgh, PA 15213, June 4, 1997					
	72 ′	EVANS The Tip of the Iceberg: RAMAC Virtual Array – Part I, Technical Support, March 1997, pp. 1-4					
Examiner Signature		Date Considered					

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Substitute	for form 1449A/PTO			Complete if Known		
_				Application Number	10/035,607	
INFO	RMATION I	DIS	CLOSURE	Filing Date	December 28, 2001	
STAT	<b>TEMENT BY</b>	A	PPLICANT	First Named Inventor	Peter F. Corbett et al.	
				Group Art Unit	2133	
	(use as many shee	ts as	necessary)	Examiner Name	Kerveros, James C.	
Sheet	4	of	6	Attorney Docket Number	112056-0031	

		OTHER PRIOR ART NON PATENT LITERATURE DOCUMENTS	
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	73 1	GIBSON, GARTH A., ET AL., Coding Techniques for Handling Failures in Large Disk Arrays, Technical Report UCB/CSD 88/477, Computer Science Division, University of California, (July, 1988.)	
	74 -	GIBSON, GARTH A., ET AL., Failure Correction Techniques for Large Disk Arrays, In Proceedings Architectural Support for Programming Languages and Operating Systems, Boston, Apr. 1989, pp 123-132	
	75 ′	GIBSON, GARTH A., ET AL., Strategic Directions in Storage I/O Issues in Large-Scale Computing, ACM Computing Survey, 28(4):779-93, December 1996	
	76,	GOLDICK, JONATHAN S., ET AL., Multi-resident AFS: An Adventure in Mass Storage, In Proceedings of the 1995 USENIX Technical Conference, pages 47-58, January 1995	
	77′	GRAHAM, SUSAN L., ET AL., Massive Information Storage, Management, and Use, (NSF Institutional Infrastructure Proposal), Technical Report No. UCB/CSD 89/493, January 1989	
	78	GRAY, JIM ET AL., Parity striping of disc arrays: Low-Cost Reliable Storage with Acceptable Throughput. In Proceedings of the 16th Very Large Data Bases Conference, pages 148161, Brisbane, Australia, 1990	
	79 ′	GRIMES, DW MARTINEZ, Two Dimensional Parity Error Correction Procedure, IBM Technical Disclosure Bulletin 2686-2689, October 1982	
	80 <	GRIMES, DW MARTINEZ, Vertical Parity Generator for Two Dimensional Parity, IBM Technical Disclosure Bulletin 2682-2685, October 1982	
	81 /	HELLERSTEIN, LISA, ET AL,. Coding Techniques for Handling Failures in Large Disk Arrays. In Algorithmica Vol. 2, Nr. 3, 182-208 (1994)	
	82 /	HUGHES, JAMES, ET AL., High Performance RAIT, Tenth NASA Goddard Conference on Mass Storage Systems and Technologies and Nineteenth IEEE Symposium on Mass Storage Systems, Adelphi, Maryland, USA, April 2002	
	83′	JOHNSON, THEODORE, ET AL, <i>Tape Group Parity Protection</i> , IEEE Symposium on Mass Storage, pp. 72-79, March 1999	
	84	KATZ, RANDY H. ET AL., Disk System Architectures for High Performance Computing, undated	
	<i>)</i> 85	KENT, JACK ET AL., Optimizing Shadow Recovery Algorithms, <i>IEEE Transactions on Software Engineering</i> , 14(2):155-168, Feb. 1988.	

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Signature	Considered	

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	86 -	KIM, MICHELLE Y., Synchronized Disk Interleaving, IEEE Transactions on Computers, C-35(11):978-988, November 1986	
***************************************	87.	KIM, MICHELLE, ET AL., Asynchronous Disk Interleaving Approximating Access Delays, IEEE Transactions on Computers, vol. 40, no.7, July 1991, pp. 801-810.	
	88	LAWLOR, F. D., Efficient Mass Storage Parity Recovery Mechanism, IBM Technical Disclosure Bulletin 24(2):986-987, July 1981	
	89´	LEE, EDWARD K., ET AL., RAID-II: A Scalable Storage Architecture for High-Bandwidth Network File Service, Technical Report UCB/CSD 92/672, (February 1992)	
	90 ^	LI, DON, ET AL., Authors' Reply, IEEE Transactions on Communications, 46:575, May 1998.	`-
	91 ′	LIVNY, MIRON, ET AL., Multi-Disk Management Algorithms, In Proceedings of the ACM International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS), pages 69-77, Banff, Alberta, Canada, May 1987	
	92 ´	MEADOR, WES E., Disk Array Systems, Proceedings of COMPCON, 1989, pp. 143-146	
	93 ′	NG, SPENCER, ET AL., Trade-Offs Between Devices and Paths in Achieving Disk Interleaving, IEEE International Symposium on Computer Architecture, 1988, pp. 196-201	
	94 -	NG, SPENCER, Some Design Issues of Disk Arrays, Proceedings of COMPCON Spring '89, pages 137-42. IEEE, 1989	
	95 /	PARK, ARVIN, ET AL., Providing Fault Tolerance In Parallel Secondary Storage Systems, Technical Report CS-TR-057-86, Princeton, November, 1986	
	96 ′	PATEL, ARVIND M., Adaptive Cross-Parity (AXP) Code for a High-Density Magnetic Tape Subsystem, IBM Technical Disclosure Bulletin 29(6):546-562, November 1985	
	97	PATTERSON, D., ET AL., A Case for Redundant Arrays of Inexpensive Disks (RAID), Technical Report, CSD-87-391, Computer Science Division, Electrical Engineering and Computer Sciences, University of California at Berkeley (1987)	
	98 🖊	PATTERSON, D., ET AL., A Case for Redundant Arrays of Inexpensive Disks (RAID), SIGMOD International Conference on Management of Data, Chicago, IL, USA, 1-3 June 1988, SIGMOD RECORD (17)3:109-16 (Sept. 1988)	

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	99	PATTERSON, DAVID A., ET AL., Introduction to Redundant Arrays of Inexpensive Disks (RAID). In IEEE Spring 89 COMPCON, San Francisco, IEEE Computer Society Press, February 27 - March 3, 1989, pp. 112-117	
Ü	100 /	STORAGESUITE "Performance Without Compromise: The Virtual Storage Architecture," catalogue, 1997	
	101,	REDDY, A. L. NARASIMHA, ET AL., An Evaluation of Multiple-Disk I/O Systems, IEEE Transactions on Computers, Vol. 38, No 12, December 1989, pp. 1680 - 1690.	
	102′	SCHULZE, MARTIN E., Considerations in the Design of a RAID Prototype, Computer Science Division, Department of Electrical Engineering and Computer Sciences, Univ. of CA, Berkley, August 25, 1988	
	103 /	SCHULZE, MARTIN., ET AL., How Reliable is a RAID?, Proceedings of COMPCON, 1989, pp. 118-123	
	104 _	SHIRRIFF, KENNETH W., Sawmill: A Logging File System for a High-Performance RAID Disk Array, CSD-95-862, January 1995	
	105 /	STONEBRAKER, MICHAEL, ET AL., <i>The Design of XPRS</i> , Proceedings of the 14 <sup>th</sup> VLDB Conference, LA, CA (1988)	
	106 ′	TANABE, TAKAYA, ET AL, Redundant Optical Storage System Using DVD-RAM Library, IEEE Symposium on Mass Storage, pp. 80-87, March 1999	
	107	TEKROM – "About RAID 6"	
	108 /	TWETEN, DAVID, Hiding Mass Storage Under UNIX: NASA's MSS-H Architecture, IEEE Symposium on Mass Storage, pages 140-145, May 1990	
	109 /	WILKES, JOHN, ET AL., The HP AutoRAID hierarchical storage system, ACM Transactions on Computer Systems, February 1996, vol. 14, pp. 108-36	
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